

FIG. 1

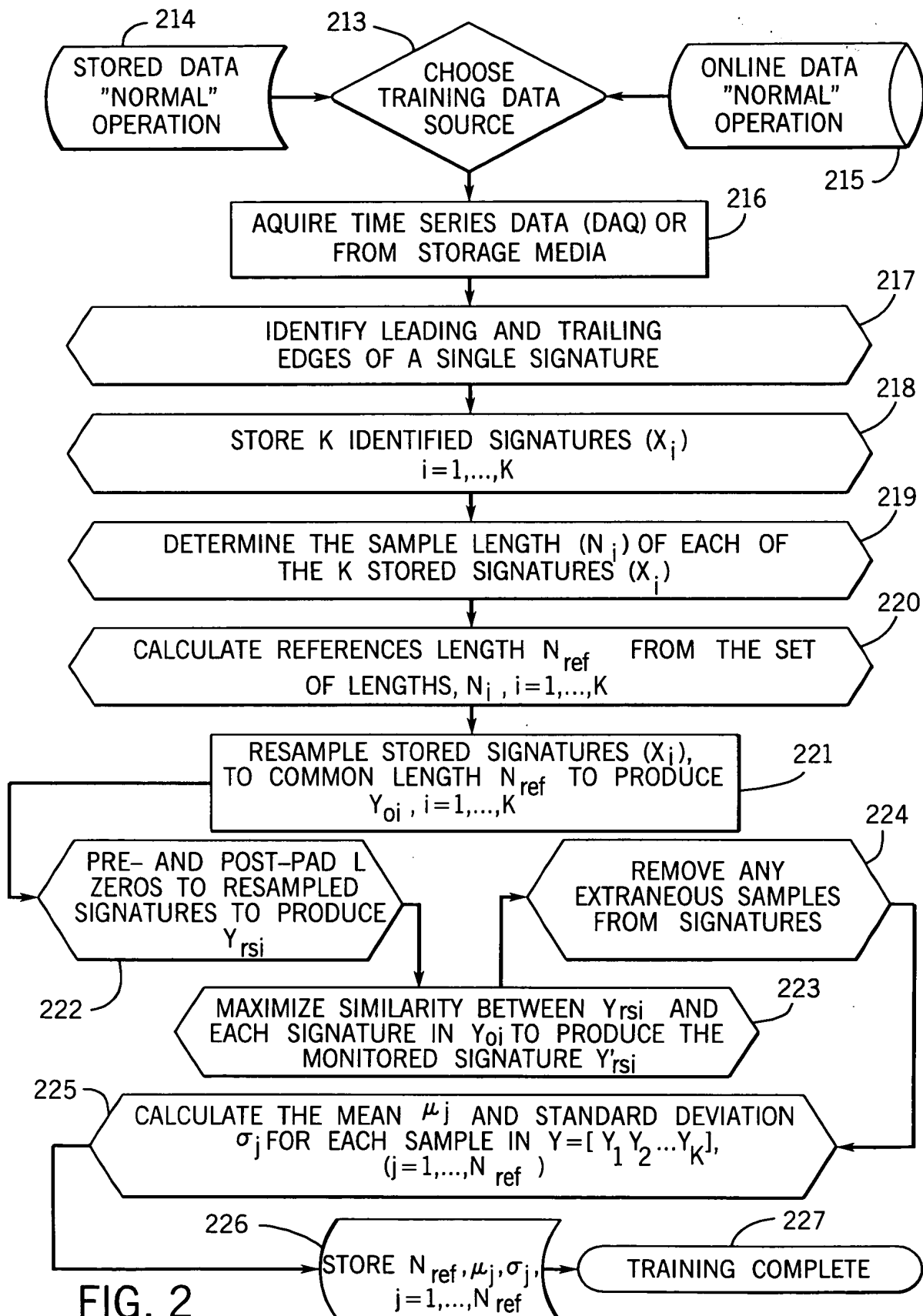


FIG. 2

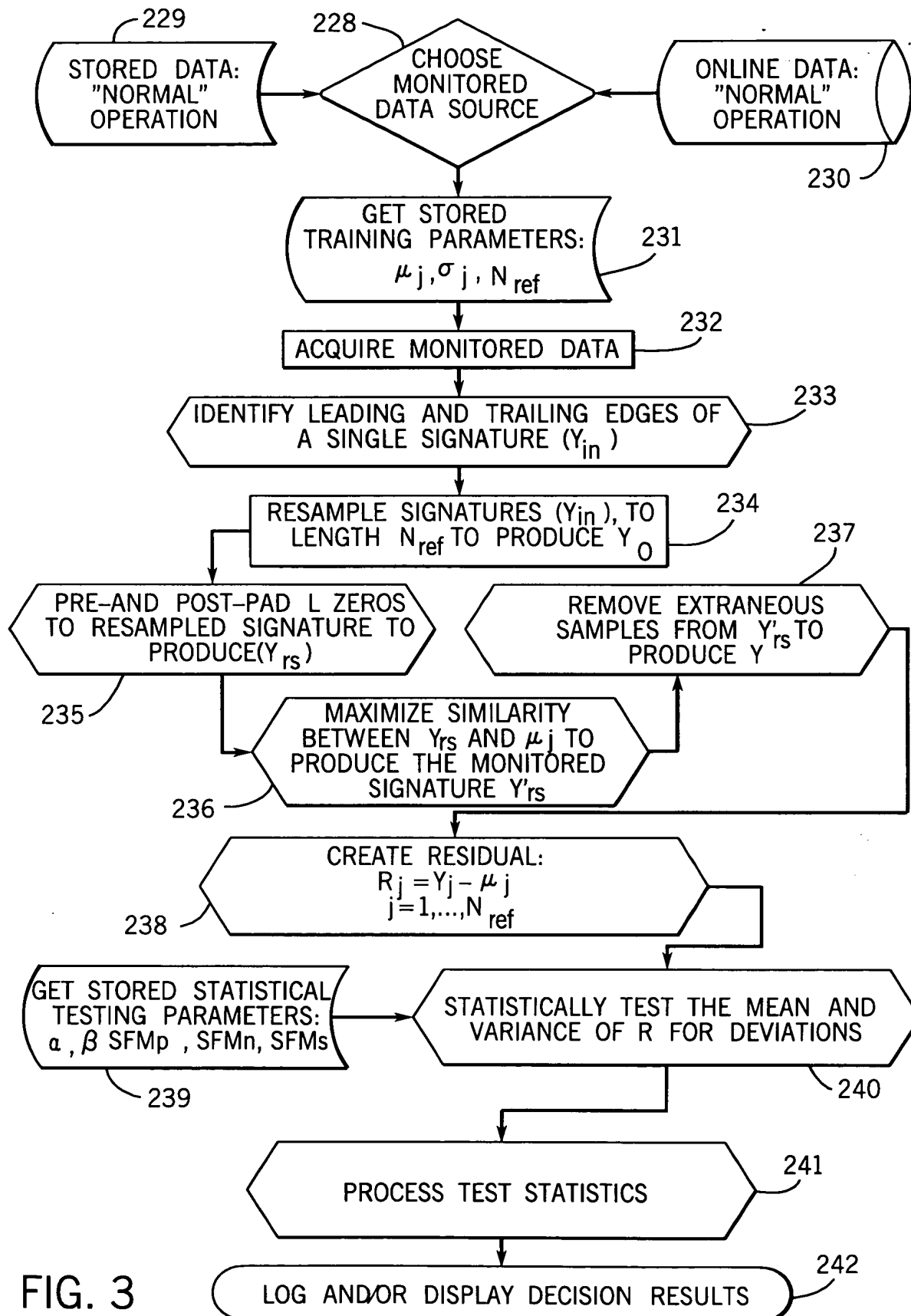


FIG. 3

FIG. 4A

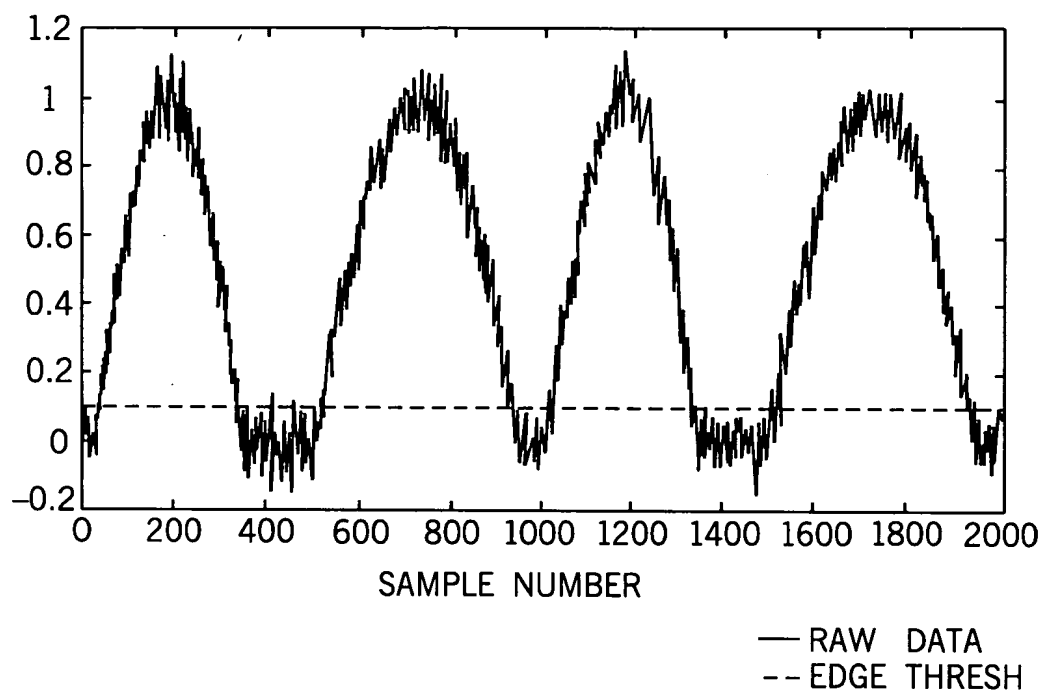
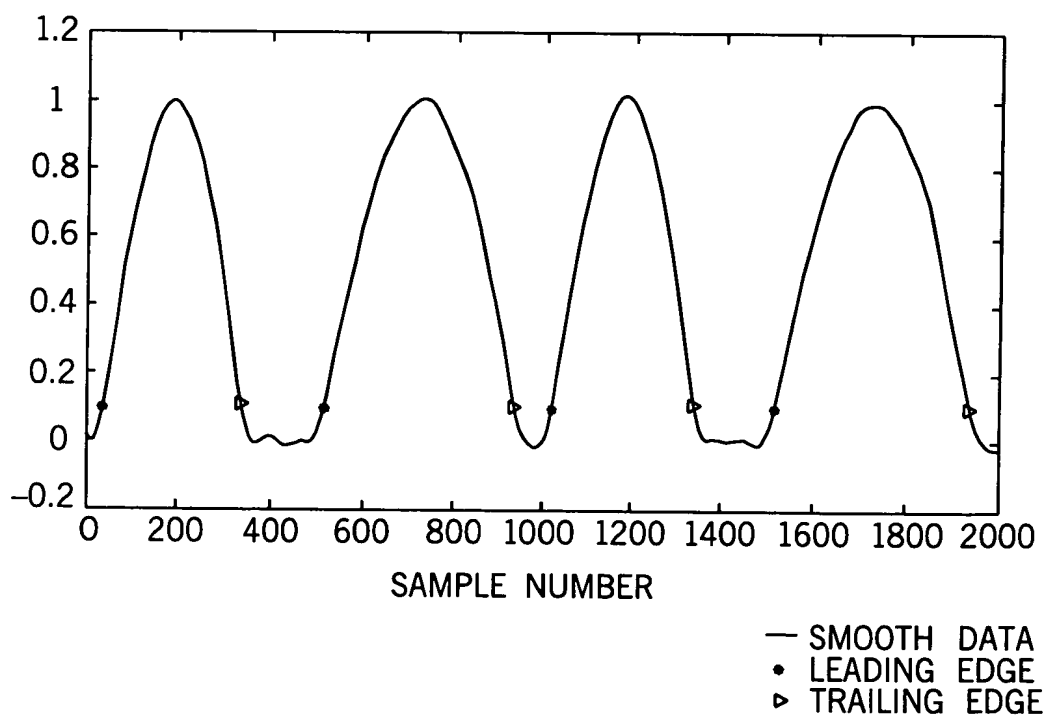


FIG. 4B



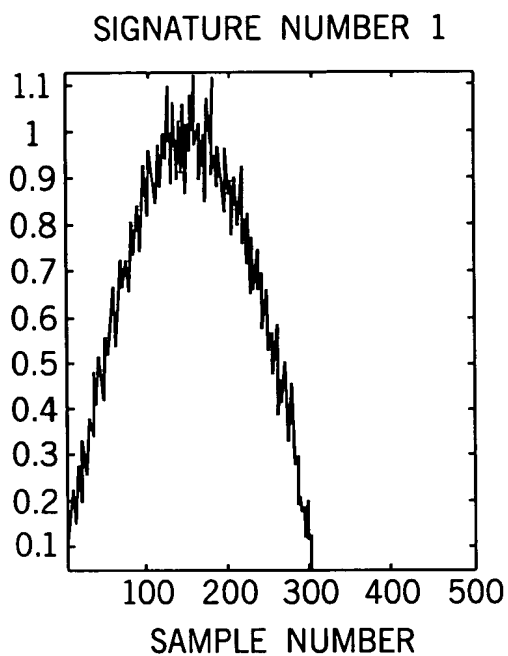


FIG.5A

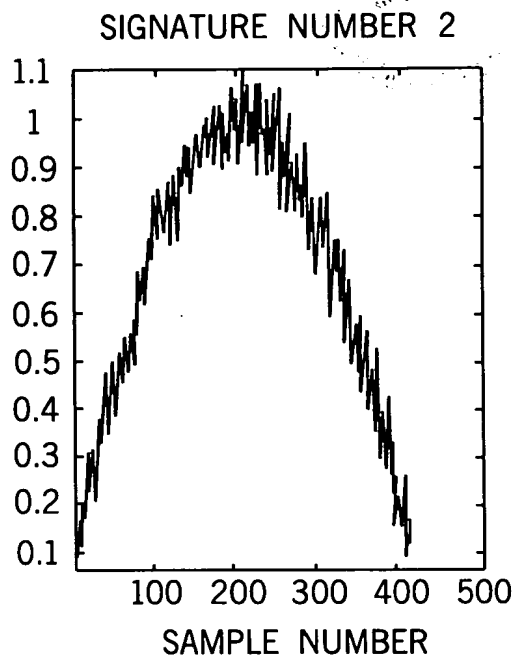


FIG.5B

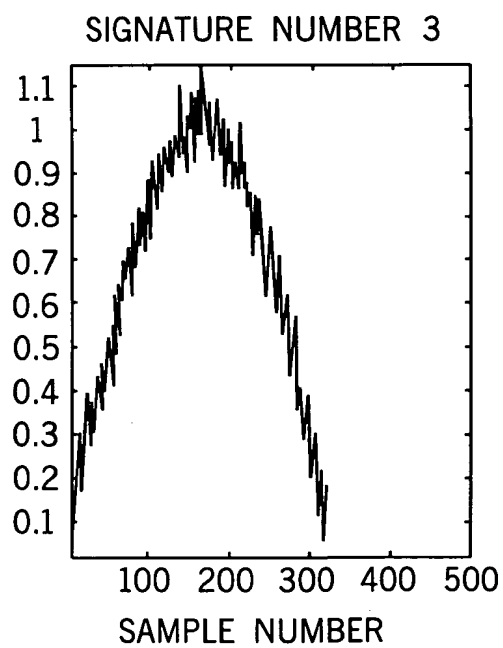


FIG.5C

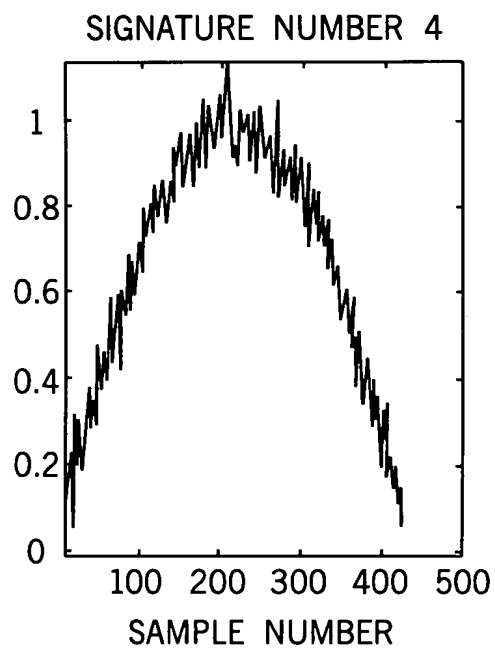


FIG. 5D

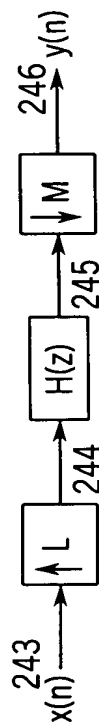


FIG. 6

FIG. 7

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graph TD
    12[INCREMENT TIME STEP] --> 18[INPUT SIGNAL]
    18 --> N1N2[PUMP1 AVG SHAFT SPEED = N1  
PUMP 2AVG SHAFT SPEED = N2]
    N1N2 --> SPRT_N1N2{SHAFT SPEED SPRT (N1,N2)}
    
    SPRT_N1N2 -- NORMAL --> 13[VALIDATE PUMP 1 SENSORS A1,B1,C1]
    13 --> SPRT_A1B1{SPRT (A1,B1)}
    SPRT_A1B1 -- NORMAL --> SPRT_A1C1{SPRT (A1,C1)}
    SPRT_A1C1 -- NORMAL --> 14[VALIDATE PUMP 2 SENSORS]
    SPRT_A1C1 -- DEGRADED --> A1_FAILED[A1 FAILED]
    A1_FAILED --> 10_1((10))
    
    SPRT_A1B1 -- DEGRADED --> SPRT_A1C1
    SPRT_A1C1 -- DEGRADED --> B1_FAILED[B1 FAILED]
    B1_FAILED --> 10_2((10))
    SPRT_A1C1 -- DEGRADED --> C1_FAILED[C1 FAILED]
    C1_FAILED --> 10_3((10))
    
    14 --> SPRT_2AB2{SPRT (2A,B2)}
    SPRT_2AB2 -- NORMAL --> SPRT_A2B2{SPRT (A2,B2)}
    SPRT_A2B2 -- NORMAL --> 15[RPM SENSORS VALIDATED]
    SPRT_A2B2 -- DEGRADED --> B2_FAILED[B2 FAILED]
    B2_FAILED --> 10_4((10))
    SPRT_A2B2 -- DEGRADED --> C2_FAILED[C2 FAILED]
    C2_FAILED --> 10_5((10))
    
    15 --> 11[PUMP DISTURBANCE ACTUATE AUDIBLE ALARM]
    
    SPRT_N1N2 -- DEGRADED --> 14_1{14}
    14_1 -- DEGRADED --> 15_1{15}
    15_1 -- DEGRADED --> 16_1{16}
    16_1 -- DEGRADED --> 11
    15_1 -- NORMAL --> 17_1((17))
    16_1 -- NORMAL --> 17_2((17))
    14_1 -- NORMAL --> 17_3((17))
  
```

PUMP
DISTURBANCE
ACTUATE
AUDIBLE
ALARM

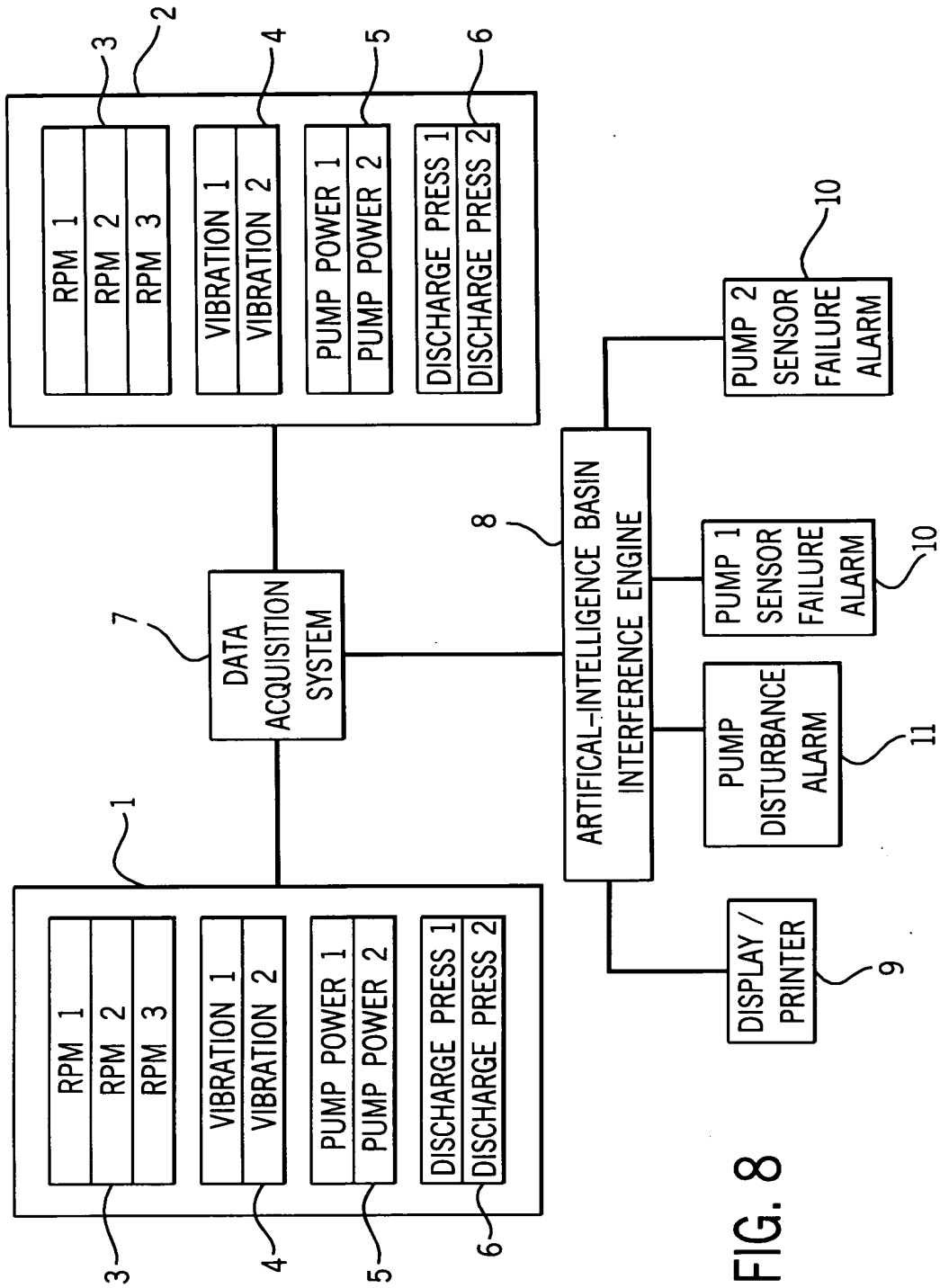


FIG. 8

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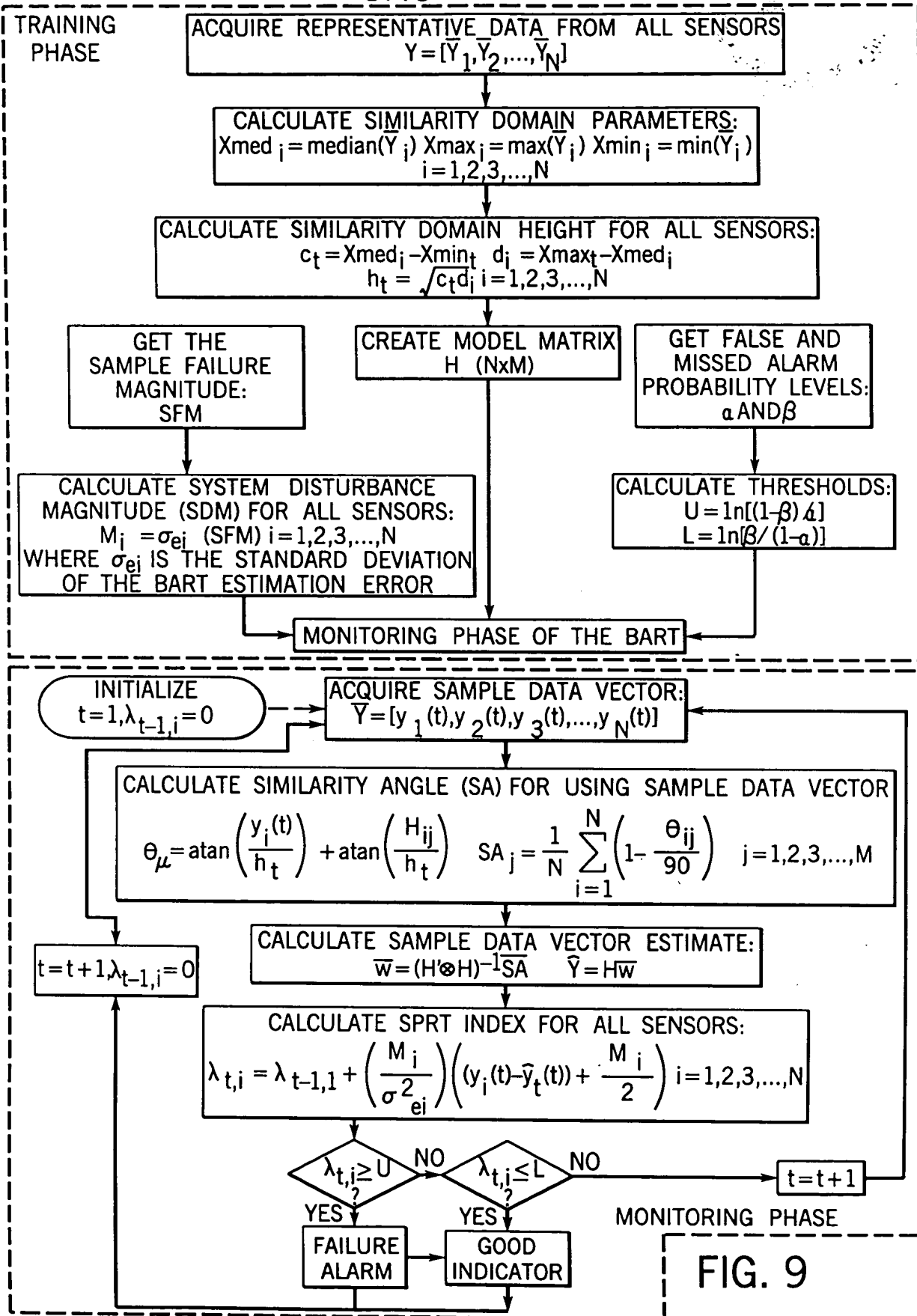


FIG. 9

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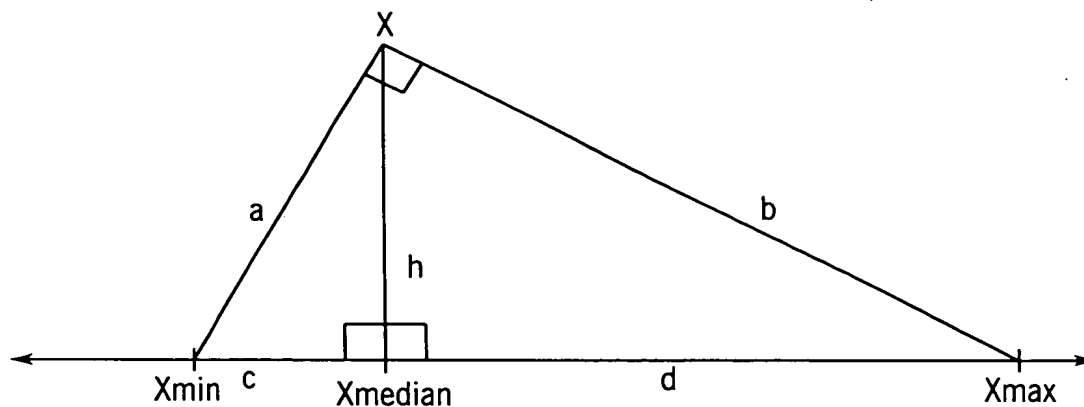


FIG. 10

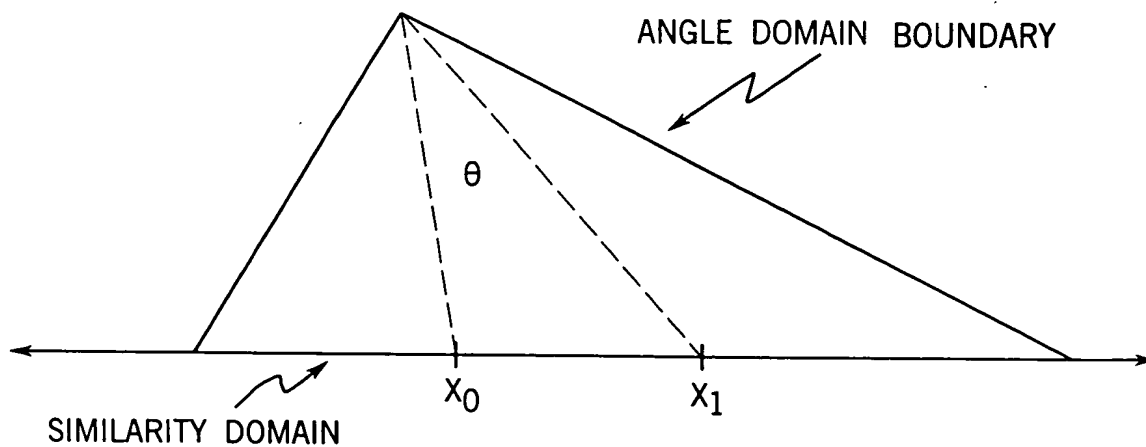
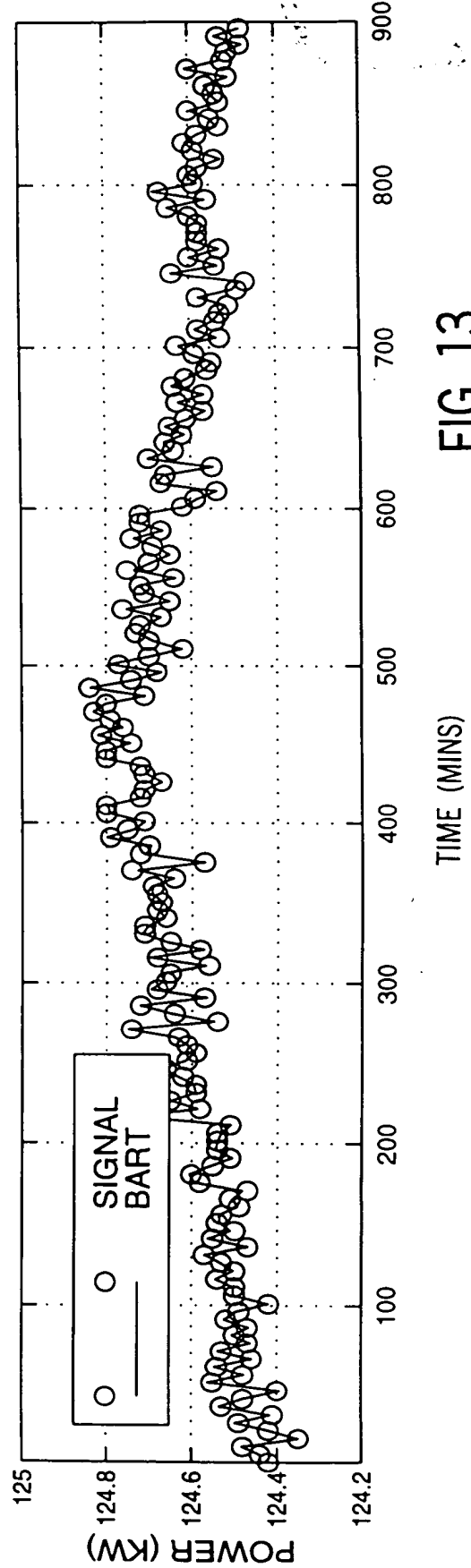
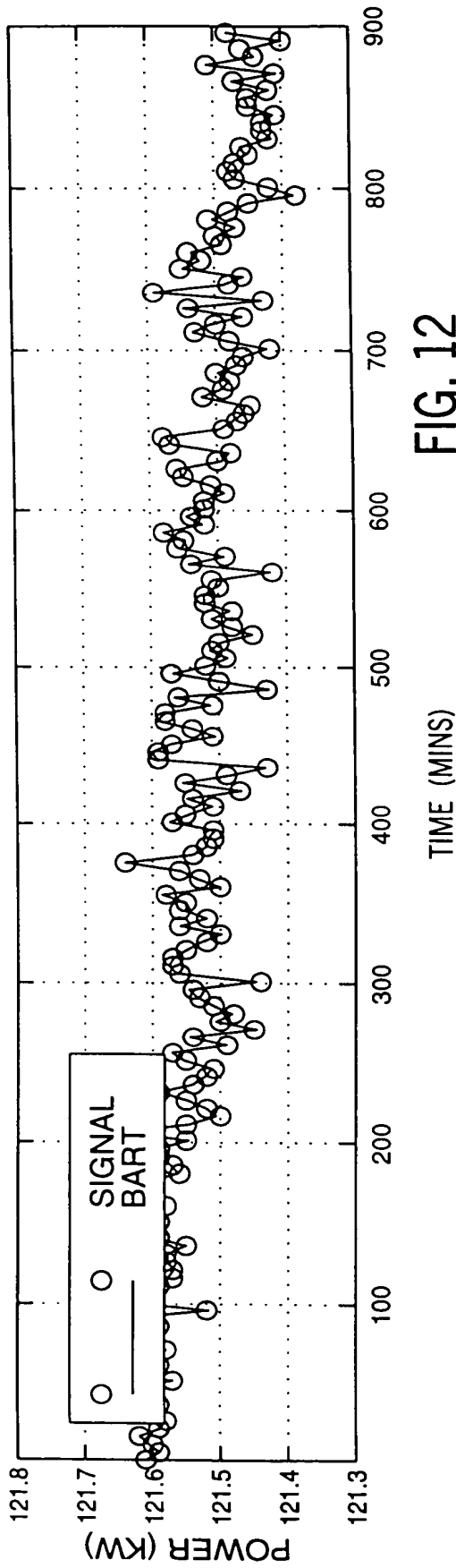
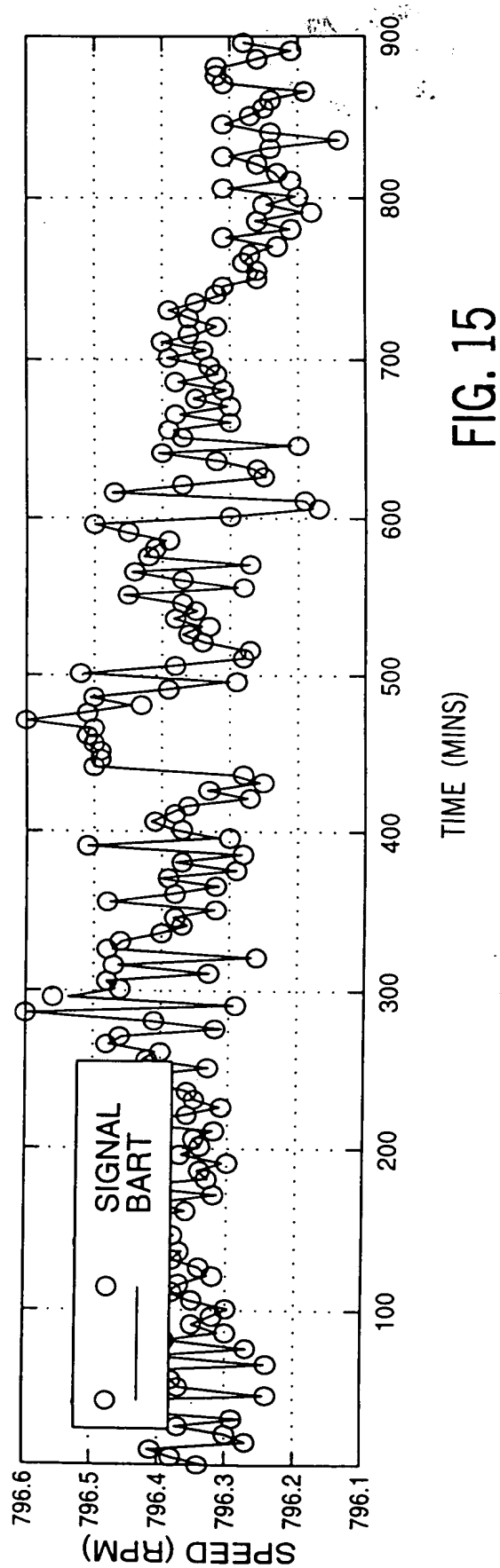
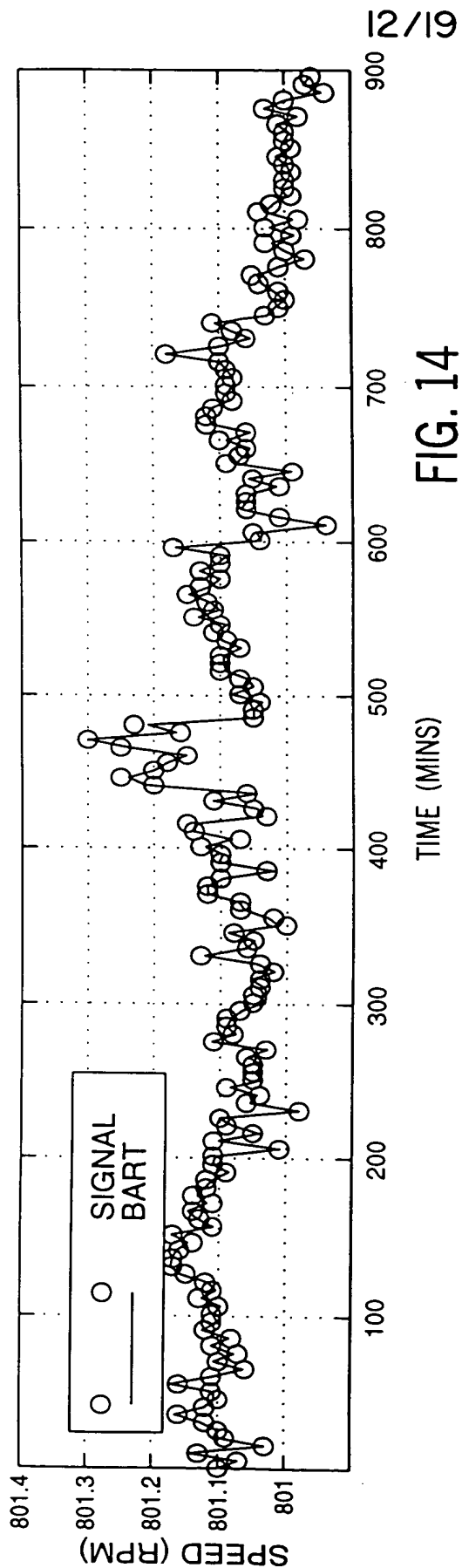


FIG. 11

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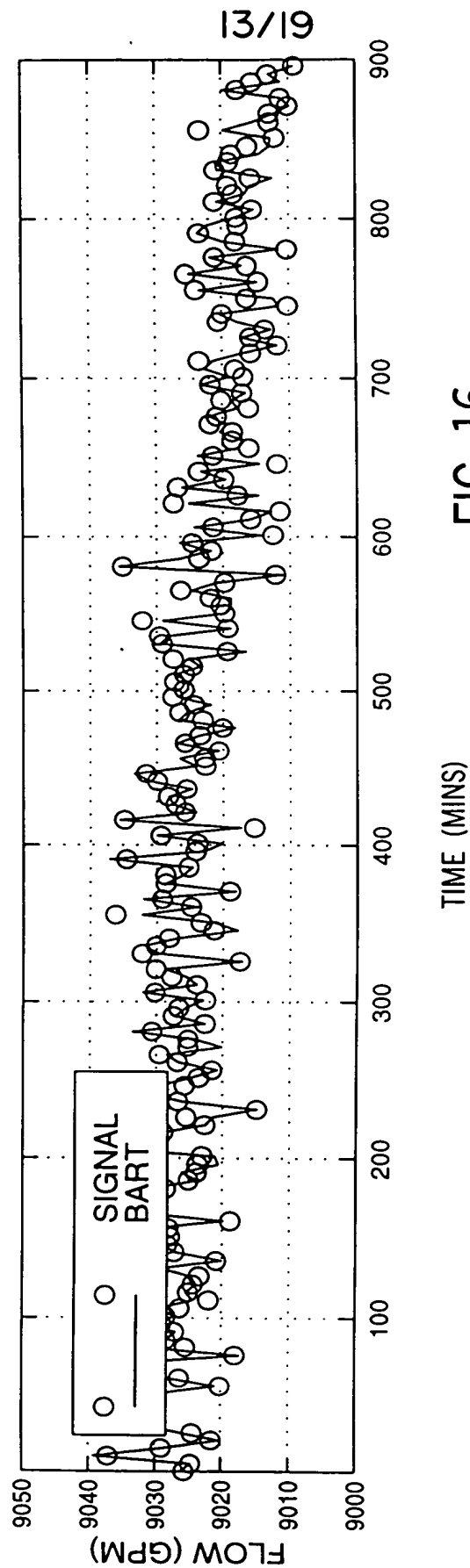
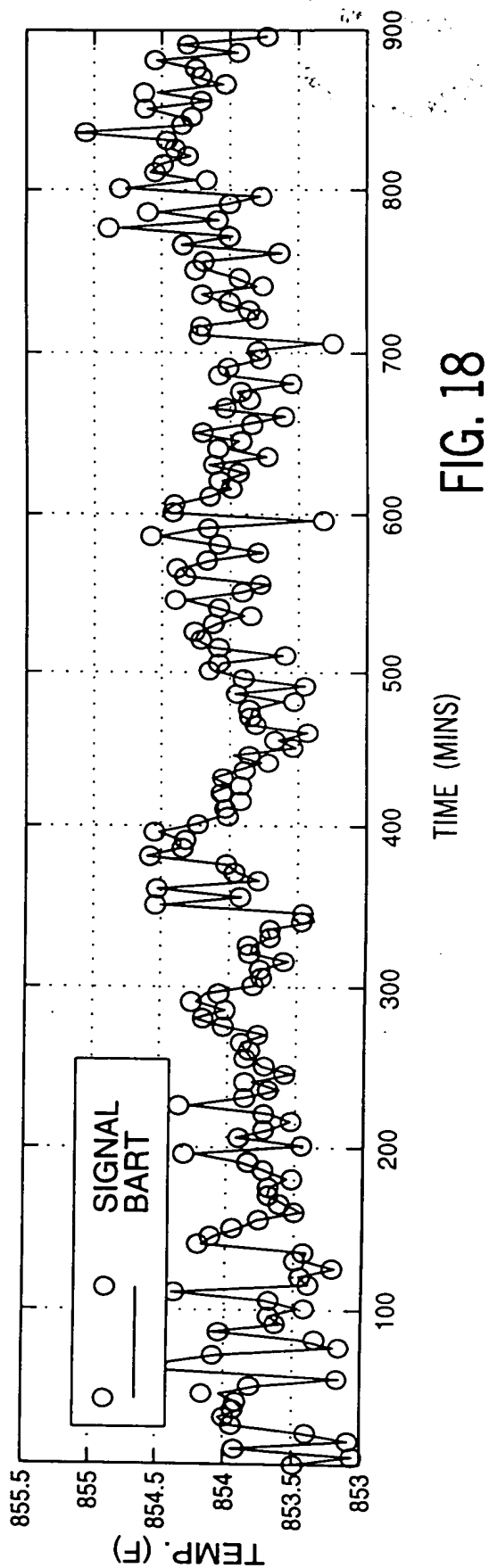
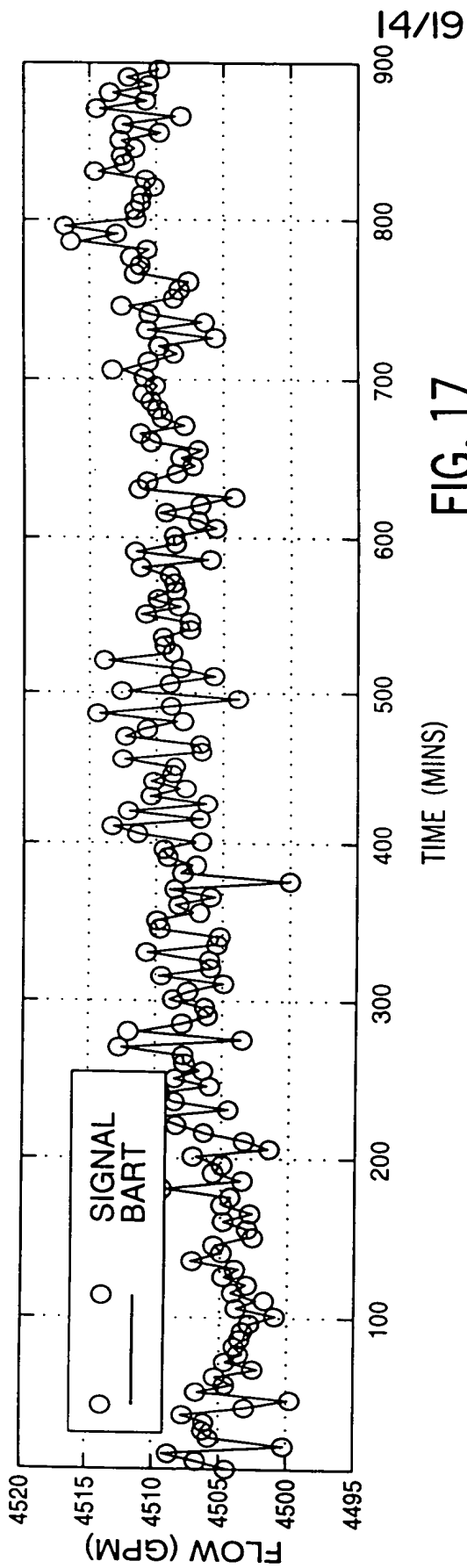
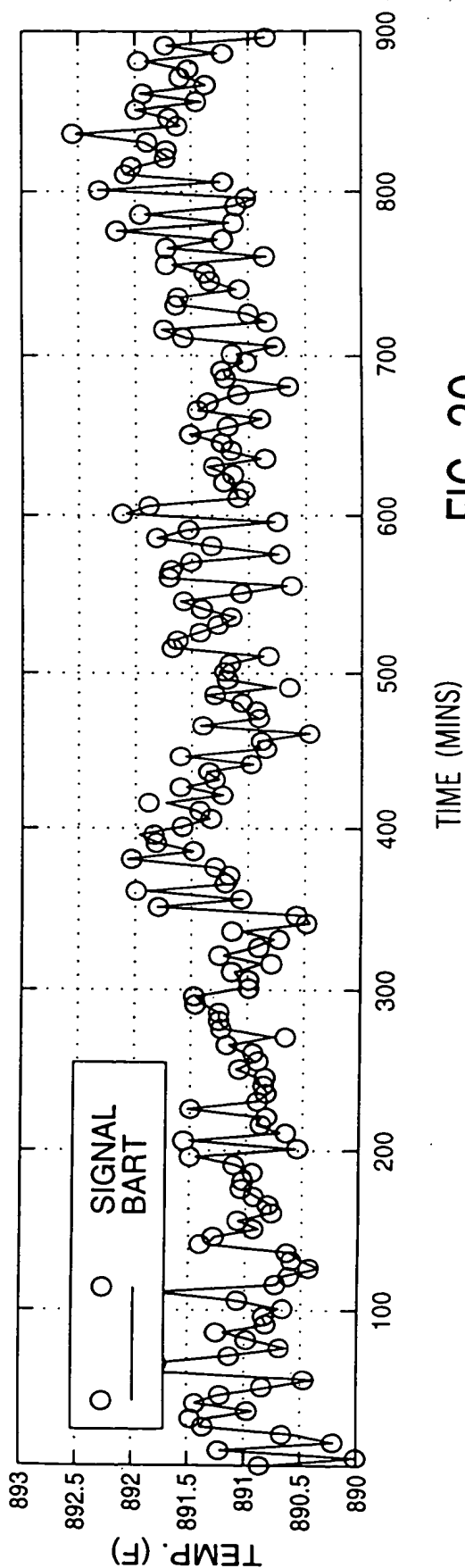
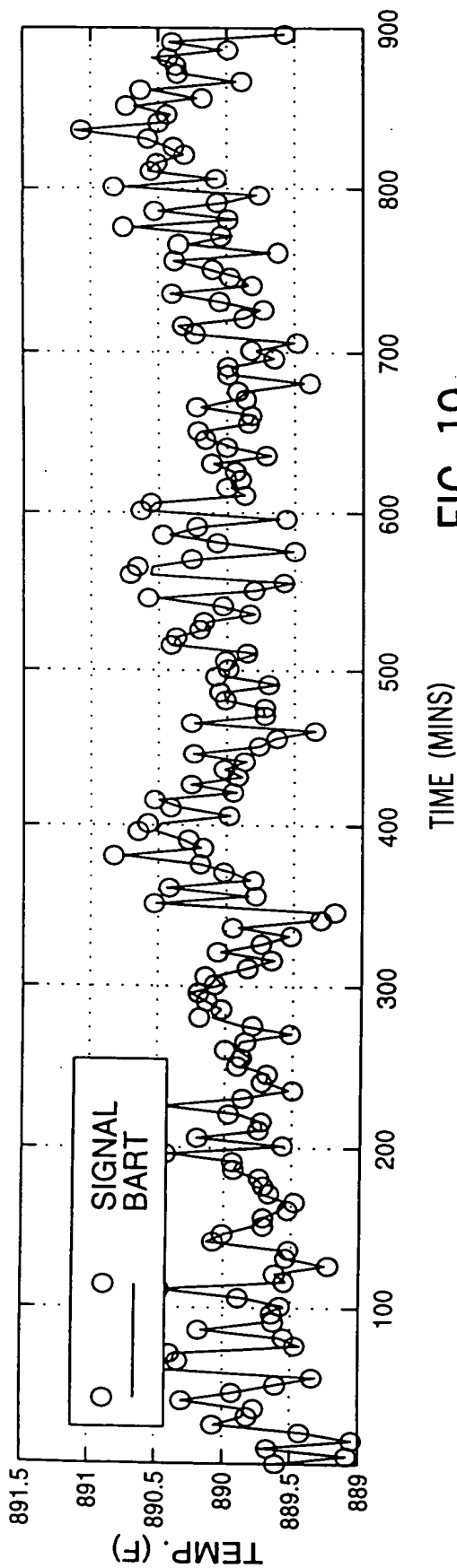


FIG. 16



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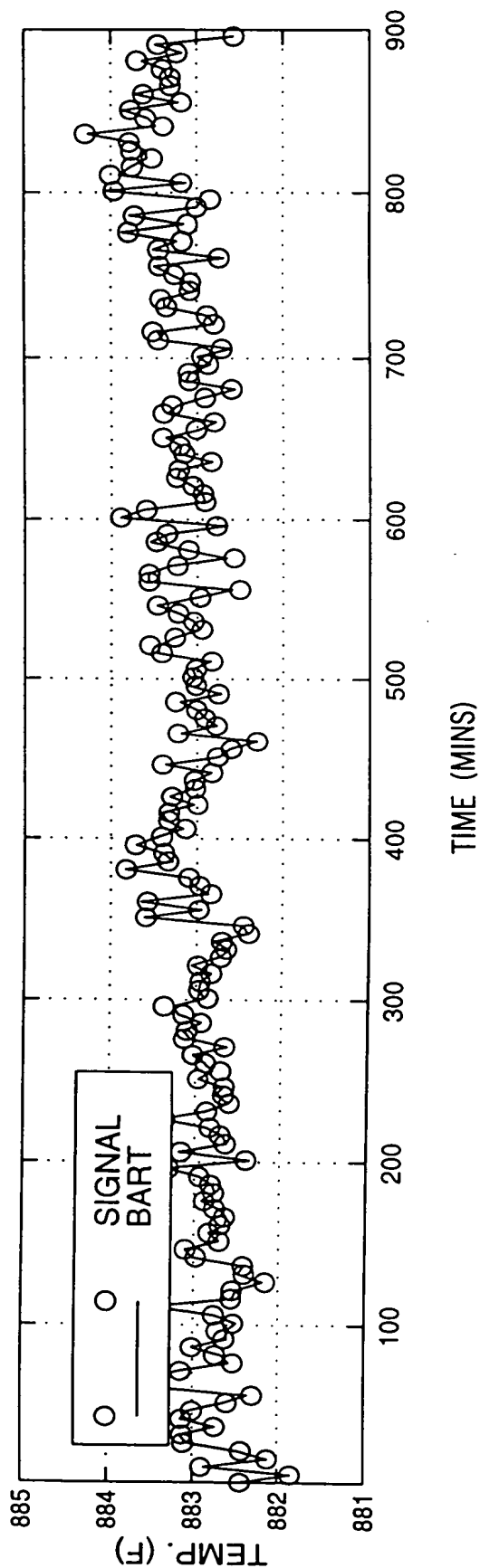


FIG. 21

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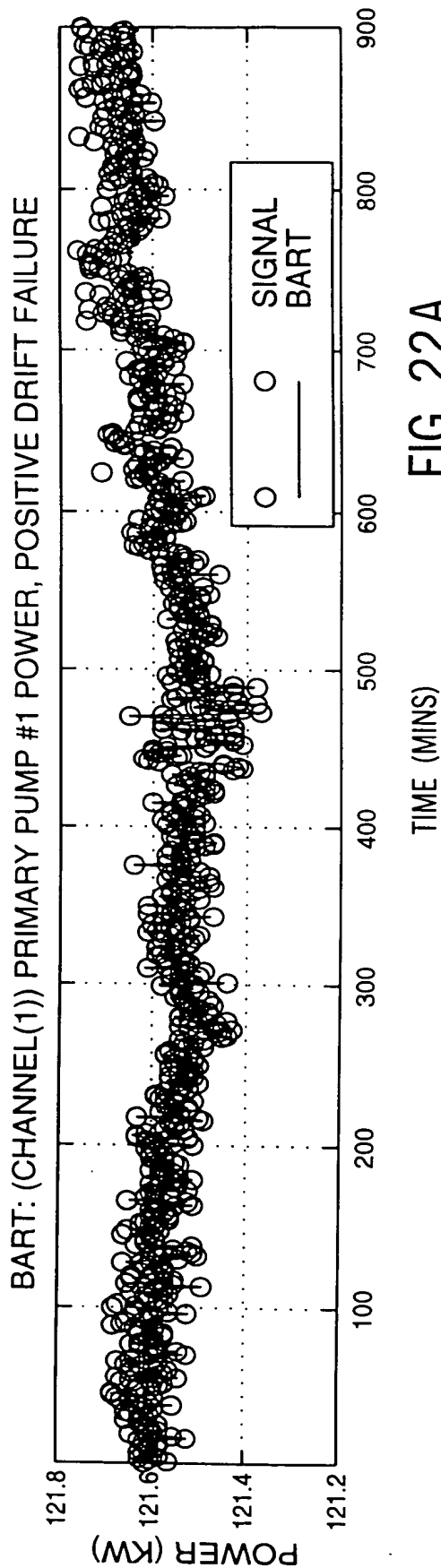


FIG. 22A

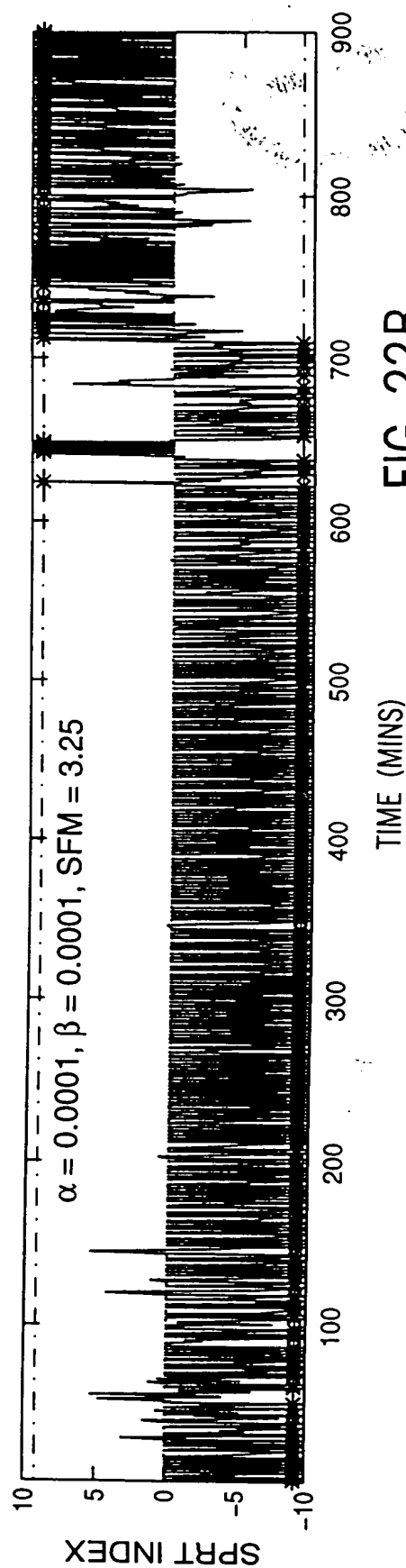


FIG. 22B

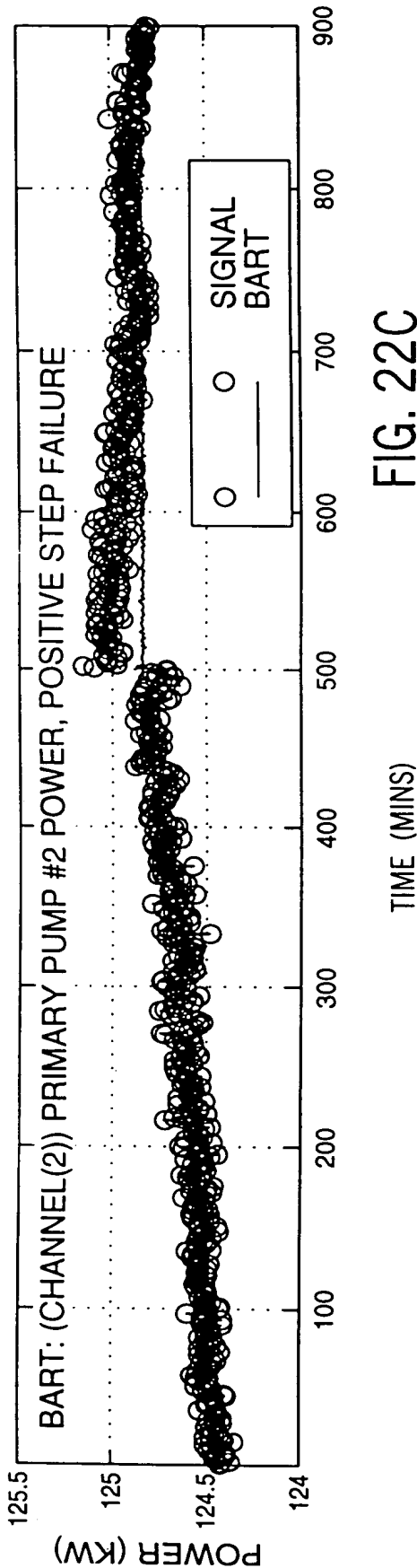


FIG. 22C

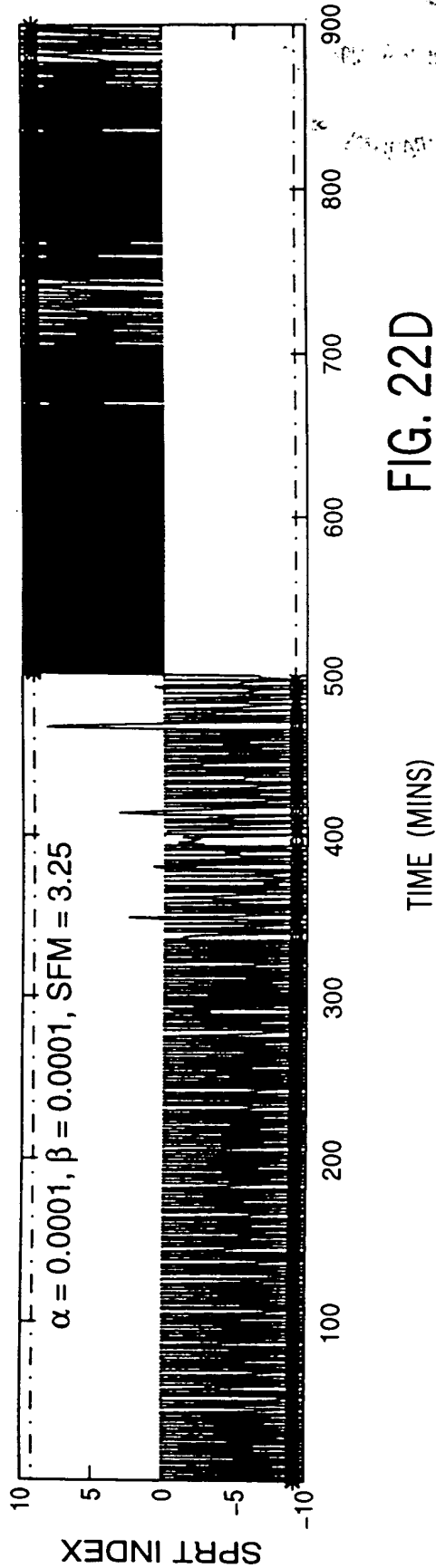


FIG. 22D

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